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The effects and factors of the real-time video in PPDR services

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The effects and factors of the real-time video in PPDR services

Jussi Simola
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Laurea-ammattikorkeakoulu **Tiivistelmä**
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Tietojärjestelmäosaamisen koulutusohjelma

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Reaaliaikaisen videon vaikutus ja tekijät viranomaistoiminnassa

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Julkisen sektorin uudistukset turvallisuusviranomaisten organisaatioissa yhdessä lakimuutosten kanssa vaativat valmiussuunnitelmiin muutoksia. Epäselvä tehtäväohjeistus suuronnettomuustilanteessa estää resurssien jakamista tehokkaasti. Opinnäytetyön tavoitteena on ollut etsiä tekijöitä, jotka vaikuttavat reaaliaikaisen päätöksenteon tukijärjestelmän käyttöönottoon ja ketkä hyötyisivät siitä.

Opinnäytetyö on tapaustutkimusten yhteenveto, joka käsittelee osatutkimuksia, joissa tutkija on ollut mukana. Tapaustutkimukset käsittelevät erilaisia tilannekuvaratkaisun käyttöön liittyviä vaikutuksia ja tekijöitä eri ympäristöissä. Tutkimusmateriaali on kerätty haastattelemalla, havainnoimalla ihmisten toimintoja työympäristöissä ja perehtymällä kirjalliseen aineistoon.

Julkisten organisaatioiden valmiustaso täytyy ottaa huomioon, kun otetaan uusia tietojärjestelmiä käyttöön. Siksi on tärkeää selvittää, mikä on julkisten viranomaisten valmiustaso paikallis- ja alue-tasolla tällä hetkellä. Lakimuutokset, tekniset infrastruktuurit, erilaiset hallintorakenteet, julkisten organisaatioiden historia ja päivitettyjen valmiussuunnitelmien puute vaikuttavat viranomaisten väliseen yhteistyöhön suuronnettomuustilanteessa. Ihminen on silti päätöksentekijä onnettomuuspaikalla, vaikka erilaiset päätöksenteon tukijärjestelmät ovat tulleet osaksi päätöksentekoa.

Viranomaiset ja poliitikot ovat huomanneet yhteisen tilannetietoisuuden merkityksen niin päivittäisessä johtamisessa kuin kriisinhallinnassakin. Kun tarkoituksena on toimia tehokkaasti yhteisen päämäärän eteen, tarvitaan oikeat ja luotettavat tiedot yhteisen tilannetietoisuuden ja tilannekuvan perustaksi. Julkisen sektorin piirissä tapahtuneet rakenteelliset muutokset kuten aluehallinnon uudistus, hätäkeskus-uudistus ja niin sanottu sote-laki ovat vaikuttaneet tavalla tai toisella julkisen sektorin työntekijöiden työprosesseihin viimeisen kymmenen vuoden aikana. Tämän lisäksi teknologiakehitys on tapahtunut nopeasti. Uudet organisaatiot tarvitsevat aina myös uusia tietojärjestelmiä. Optimaalinen tilannetietoisuus suuronnettomuustilanteessa voidaan saavuttaa julkisessa sektorissa vain jos on teknologisia, inhimillisiä ja materiaalisia resursseja.

Asiasanat: tilannetietoisuus, tilannekuva, päätöksenteon tukijärjestelmä, tilannekeskus

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Abstract

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The effects and factors of the real-time video in PPDR services

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Reforms in public sector and changes in public safety organizations with legislative amendments require changes in preparedness plans. Unclear tasks descriptions in a case of a major accident prevent allocating resources effectively. The main objective of the thesis work was to point out those factors which effect to the introduction of new technology and working environments where it would enhance rescue operations.

This thesis summarizes and represent case studies where the researcher has taken part in. These case studies present effectiveness and factors of situational awareness solution in different environments. The materials of this study was gathered by interviews, observation in the field and literature reviews.

Public safety organization´s level of preparedness must be taken into consideration when implementing new information systems. Therefore, it is necessary to find out what is the level of preparedness in public organizations at present. Changes in legislation, technical infrastructures, different structures of administration, history of public safety organizations and lack of updated preparedness plans affect to cooperation within PPDR authorities in the field of a major accident. A human is still the decision maker at the scene of the accident, although different kind of decision support systems have become a part of decision-making.

PPDR authorities and politicians have recognized the importance of a common situational awareness in preparation for the future. When the purpose is to work effectively towards a common goal or solve various challenges, accurate and reliable information is needed as a basis for situational awareness. It is also called as a common overall picture. Optimal overall situational awareness from the major accident can be reached in the public sector only if there are a technological, human and material resources.

Keywords: Situational awareness, situational picture, Decision Support System, situation center

List of Abbreviations & Symbols

C2	Command and Control
CSR	Case Study Research
DSS	Decision support system
ERICA	Emergency Response Integrated Common Authorities
EUCISE2020	European Union Common Information System Environment
EU	European Union
GDACS	Global Disaster Alert and Coordination System
ICT	Information and Communication Technology
IS	Information System
IT	Information Technology
KEJO	Common field command system for all public safety actors
LAUREA	Laurea University of Applied Science
MACICO	Multi-Agency Cooperation in Cross-border operations
MAV	Micro Air Vehicle
MOBI	Mobile Object Bus Interactive
NATO	North Atlantic Treaty Organization
NAUN	North Atlantic University Union
OCHA	United Nations Office for Coordination of Humanitarian Affairs
PPDR	Public Protection and Disaster Relief
PeIP	IP-based data network subscription provided by State Security Networks
PEKE	Field command system for rescue department
POKE	Field command system for police
R&D	Research and Development
SA	Situational Awareness
SSA	Shared Situational Awareness
TETRA	Terrestrial Trunked Radio
TUVE	Security Network -project
USA	United States of America
UAS	Unmanned Aircraft System
U.S.	United States

List of Publications

P[1] M. Daifi, P. Kiiski, M. Viuhko, J. Simola. Functional level user requirements for paramedic work in ambulances: Finland and globally. Paper is presented in MOBI-conference, Espoo, 31.5.2013.

P[2] J. Simola, J. Rajamäki. Using a Real-time Video to Allocate Public Protection and Disaster Relief Resources in Rescue Service Process. Case: Natural Disaster in the Viksu 2014 Young Fire-fighters Camp, 5th European Conference of COMPUTER SCIENCE (ECCS '14), Geneva, Switzerland, December 29-31, 2014, ISBN: 978-1-61804-264-4, pp. 56-62

P[3] J. Simola, E. Jokinen, J. Rajamäki. How situational awareness can be improved by using real-time video? Case: simulated natural disaster at the Viksu 2014 camp, International Journal of systems applications, engineering & development. Under review.

P[4] J. Simola, J. Rajamäki. How real-time video solution can affect the level of preparedness in situation centers. The publication is sent to The Second International Conference on Computer Science, Computer Engineering, and Social Media (CSCESM2015) that will be held in Lodz, Poland on September 21-23, 2015.

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1 INTRODUCTION

Public Protection and Disaster Relief (PPDR) services such as the police, the fire brigade and emergency medical services (EMS) are tasked with the challenge of providing the first response in life critical circumstances. The ability to create right situational awareness and reliable communication with each other are the most important things at the disposal of the PPDR services. Therefore, public safety organization´s level of preparedness must be taken into consideration when implementing new information systems. It is necessary to find out what is the level of preparedness in public organizations at present. Changes in legislation, technical infrastructures, different structures of administration and history of public safety organizations are factors that affect to the level of preparedness.

This thesis summarizes and represents four case studies where the researcher has taken part in. These case studies present effectiveness and factors of situational awareness solution in different environments. The main objective of the thesis work is to point out those factors which effect to the introduction of new technology.

The first case study handled user needs regarding user requirements in ambulances. The second case study handled technological user requirements of PPDR authorities and it was based on empirical fieldwork at Viksu Young Firefighters Camp 2014 in Pori. The third case study is an extended research of the second case study with a wider and deeper knowledge base. The fourth case study deals with how a real-time video solution can affect creating situational awareness to level of preparedness in situation center. Four regional command/ situation centers were selected to be researched in an empirical study: the Southwestern Finland Police department, the Southwest Finland Emergency Services, the Hospital District of Southwest Finland and the Finnish Border Guard in Turku. The Finnish Border Guards have their own main situation/command center in Turku. It is called the Maritime Rescue Coordination Centre.

These four case studies are a part of three national and international projects: MOBI (Mobile bus interactive), MACICO (Multi-Agency Cooperation in Cross-border operations) and EU-CISE2020 (European Union Common Information System Environment). All these projects have the same purpose of enhancing the operational work of PPDR authorities with ICT-solution. To combine critical infrastructure with daily works is important to reduce costs and overlapped procedures. Laurea University of Applied Sciences and partners (Ajeco, Cassidian, Airbus Defence and Space, Eye Solutions, PPDR authorities and TEKES) have enabled students to participate in research and development of these information systems.

1.1 Central concepts

Public Protection Disaster Relief (PPDR)

The term “Public Protection” is used to describe critical public services that have been created to provide primary law enforcement, firefighting, emergency medical and disaster recovery services for the citizens of the political subdivision of each country. These workers help to ensure the protection and preservation of life and property. The term Public Safety and Disaster Response, within certain regions, can also be construed as PPDR. (Baldini 2010.)

Situation center and Command and control center (C2)

Situation center means the place where PPDR authorities make decisions to allocate resources to the right proportion. The words Command and Control individually and collectively mean different things to different communities (Alberts & Hayes 2006). For example C2, situation center or Emergency Operation Room is a physical (e.g., a conference room) or virtual (e.g., telephone conference call) location designed to support emergency response, business continuity and crisis communications activities. PPDR authorities meets at the C2 -room to manage preparations for an impending event or manage the response to an ongoing incident. By gathering the decision makers together and supplying them with the most current information, better decisions can be made. (Ashish et al. 2007.)

Decision support system

Decision support system is based on decision making and situational awareness. Decision support systems are used to track key incidents and the progress of responding units, to optimize response activities and to act as a mechanism for queuing ongoing incidents. (Ashish et al. 2007; Endsley 1995; Endsley 1988.)

Golden hour

Golden hour means that trauma patients have better outcomes if they are provided definitive care within 60 minutes of the occurrence of their injuries. The golden hour justifies much of the current trauma system. Out-of hospital care concepts such as scoop and run, aeromedical transport and trauma center designations with trauma teams in place are, in part, predicated on the idea that time is a critical factor in the management of injured patients. (Lerner & Moscati 2001.)

Dsip

The DSiP (Distributed Systems intercommunication Protocol) was invented and developed by Ajeco. The system allows combining all kinds of telecommunication resources into a single, uniform and maintainable system. Ajeco participates in the project for developing and improving roaming capability and adding traffic engineering capabilities aimed at interoperable use, but not limited to, of TETRA, Tetrapol, 3G, 4G, Satellite communication resources. (Rajamäki et al. 2010.)

Situational awareness and situational picture

According to Ministry of defence (2010) situational awareness means that the understanding of decision-makers and their advisors of that has happened, the circumstances under which it happened, the goals of the different parties and the possible developments of events, all of which are needed to make decisions on a specific issue or an entity of issues. A general definition of situational awareness is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future (Endsley 1988). "Situational awareness is the ability to identify, process, and comprehend the critical information about an incident. It is knowing what is going on around you. Situational awareness requires continuous monitoring of relevant sources of information regarding actual incidents and developing hazards." (Homeland Security 2008, 58.)

Situational picture refers to a presentation on a situation or capabilities, compiled on a basis of individual pieces of information, which provides the grounds for situational awareness. A situational picture can be a general assessment, drawn up at regular intervals. Strategic situational picture is more detailed analysis of a current topic or topics where events and their impacts are assessed. This kind of descriptive situational picture can be provided to decision-makers on a regular basis for example, three times a year or once a week. A situational picture can also be a more often (for example daily or hourly) drafted report or a compilation of events which is made available in the information system for actors. Normally it does not contain assessments of situational developments or recommendations for measures. An operational situational picture is compiled and updated as much in real time as possible during a disturbance. Through continued monitoring and updating it should provide a picture of the development of events and thus enable the management of the situation and the management process required to solve the situation. A decision maker must be able to trust that the conveyed situational picture is a reliable one in all its details and that the analyses are made with the best possible expertise. (Ministry of defence 2010, 58.)

Government situation centre

Government situation centre ensure that the state leaders and central government authorities are kept informed continuously. The government situation centre has the duty to alert the government, permanent secretaries and heads of preparedness and to call them to councils, meetings and negotiations at exceptional times required by a disruption or a crisis. (Ministry of defence 2010.)

The ministries have the duty to submit the situational picture for their entire administrative branch to the government situation centre and notify the centre of any security incidents in their field of activity. In suddenly evolving situations, the government situation centre also receives incident reports of security incidents directly from the PPDR authorities. In addition, the government situation centre follows public sources and receives situational awareness information in its role as the national focal point for certain institutions of the European Union and other international organizations. (Ministry of defence 2010.)

1.2 Laurea´s projects

Mobi

The objective of the MOBI project (Mobile Object Bus Interaction) was to enhance information and communication technology (ICT) integration of Emergency vehicles and create a base for Emergency vehicle´s ICT concept suitable for commercializing. It addressed the above issues through a user-centered program of research that culminated in new recommendations and designs for an integrated platform for use in emergency vehicles. (Rajamäki et al. 2010.)

Macico

The MACICO project's goal was to develop telecommunication solutions that are viable in various complex and demanding public safety incidents. The MACICO project's goal was to develop telecommunication solutions that are viable in various complex and demanding public safety incidents. (Drouglazet et al. 2014.)

Eucise 2020

CISE is since 2009 being developed jointly by the European Commission and European Union / European Economic Area Member States including civilian and military authorities as well as the European agencies operating in the maritime field. It will create a political, organizational and legal environment to enable information sharing across the seven relevant sectors

(transport, environmental protection, fisheries control, border control, general law enforcement, customs and defence) based on existing and future surveillance systems and networks with a view to achieve a fully operational EUCISE by 2020. (Eucise2020.)

1.3 Backgrounds of research

Public Protection and Disaster Relief (PPDR) services such as the police, the fire brigade and emergency medical services (EMS) are tasked with the challenge of providing the first response in life critical circumstances. The ability to create right situational awareness and reliable communication with each other are the most important things at the disposal of the PPDR services. (Baldini 2010.)

First responders are often the first people at the scene of an emergency. They may be fire fighters, border guards or people with similar responsibility for the safety or well-being of the community.

The first hour after the onset of out-of-hospital traumatic injury is referred to as the “golden hour”. Patients who are in the operating room within one hour of injury have a much higher survival rate (Lerner & Moscati 2001). This is one example, why quickly offered and reliable real-time information is necessary for emergency responders and decision makers.

2 LEGISLATION

2.1 National safety environment

Under the Emergency Powers Act (1552/2011), the authorities can be given powers that are necessary to protect the population and its subsistence and the national economy; to maintain the judicial system and fundamental and human rights; and to safeguard Finland's territorial integrity and independence. Even in emergency conditions, wider powers can only be used if the situation cannot be controlled through the authorities' regular powers.

The existence of emergency conditions are:

- an armed attack on or immediate aftermath threat of an armed attack on Finland
- a particularly serious event or threat which impacts the population's subsistence or the foundations of the national economy
- a particularly serious major accident and its immediate aftermath
- a widespread dangerous communicable disease having effects comparable to those of a particularly serious major accident.

2.1.1 Preparedness for emergency conditions

The Government, the state administrative authorities, state businesses and other state authorities as well as municipalities shall ensure, by means of emergency plans, prior preparation of emergency operations and other measures, that their duties will be performed with the least amount of disruption also in emergency conditions. Preparedness for emergency conditions shall be managed, supervised and coordinated by the Government and by each Ministry in its field of operation. (Emergency Powers Act 2011.)

2.1.2 Standard of services

According to Rescue act (379/2011) regional rescue services decide on the standard of services after hearing the opinions of the municipalities. The decision shall specify the threats in the region and assess the risks arising from them, and also determine the objectives of the operations, the available resources and services and the standard of service. The decision on the standard of service shall also contain a plan on the further development of the standard of service. (Finnish Rescue Act 2011.)

According to Health care act (1326/2010) joint municipal authorities for hospital districts shall provide prehospital emergency medical services in their area. Emergency medical services shall be planned and implemented in cooperation with units providing emergency medical care so as to form a regionally coherent system. Joint municipal authorities for hospital districts shall determine the standard of service required of emergency medical services. The service standard decision shall lay down the procedures to be followed in the provision of emergency medical services, the scope of the services, the qualifications required of personnel participating in emergency medical care, response time targets, and other issues pertinent to the provision of emergency medical services in the area. The service standard decision shall include a description of the scope of emergency medical services, ensuring that the services can be provided efficiently and expediently and taking into consideration situations where demand for emergency medical services exceeds normal supply. (Health Care Act 1326/2010.)

2.1.3 The Emergency Response Centre act

The Emergency Response Centre Administration handles emergency calls for the rescue, police and social and health services and relays the information they receive to the appropriate authorities or partners (Emergency Response Centre Act 692/2010).

Tasks of Emergency Response Centre Administration is defined in Emergency Response Centre Act (692/2010). According the law, the tasks include:

- Providing emergency response centre services.
- Supporting the operations of the police, rescue services, Social and health services. Supporting activities for rescue services, the police and the social and health care authorities, such as measures related to the transmission of the notification or task, the message center tasks, the launch of warning measures of the population in acute danger and the other tasks related to the support of public authorities that the ERC is now appropriate to take care of (support services); together with Developing and controlling tasks and procedures related to Emergency Response Services.

Related to producing emergency response services are defined in Government Decree on the Operation of Emergency Response Centres.

According to the government decree (877/2010) on the operation of emergency response centres are:

1. Searching for work safety precautions information.
2. Additional alerting and definition of the alarm response.
3. Launching emergency populations warning. Warning of the population in accidents and dangerous situations and the alarm system required for the purpose
4. Forwarding of emergency announcements, other official announcements and operative bulletins
5. Investigating and forwarding the authenticity of the information to the authorities
6. Relay and provide requested executive assistance to the authorities.
7. Forwarding preannouncement concerning major accidents involving multiple patients to hospitals.
8. Registry queries, information retrieval, searching for contact information, forwarding requested executive assistance, recording of the measures.

3 RESEARCH METHODOLOGY

3.1 Schedule of the research process

Figure 1. Research process

Schedule of the research process is described in figure 1. The first research and development course regarding Mobi -project was held on spring 2013. During the Macico -project were made two case study researches. Final case study belongs to EUCISE 2020 -project.

The aim of the thesis was to find out effectiveness and factors of real-time video in operational work of PPDR authorities thus understanding history helps to understand present and those factors can affect developing technology solutions in the future. Empirical approach helps to understand entity. Choosing a case study research strategy enables investigation of interaction between the different factors.

Implementing new technology in public safety environment requires overall awareness of current situation in environment of public safety organisations. There should be awareness of level of preparedness in between public organizations.

3.2 Case studies in Information System research

In this thesis case studies create framework to develop information systems. The multimethodological approach consists of four research strategies: theory building, experimentation, observation, and systems development (Nunamaker et al. 1991). This cycle is ongoing, shown in figure 2.

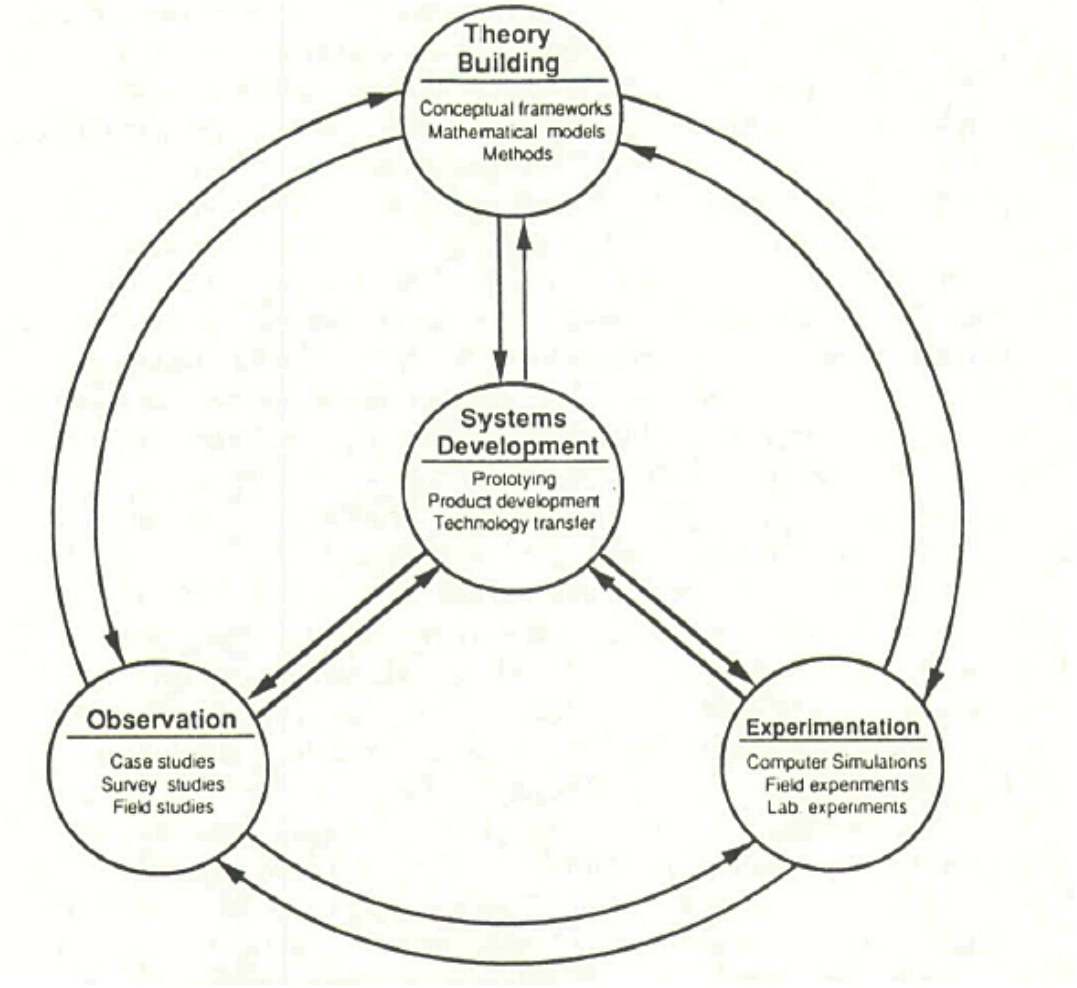

Figure 2. Multimethodological approach to IS framework (Nunamaker et al. 1991).

3.3 Multiple-case study formation

In this study, the multiple-case study approach was used; the used method is well known and explained fine in references (Benbasat et al. 1987; Kananen 2013; Miles & Huberman 1994; Yin 2014).

Yin (2014, 29) identifies five components of research design for case studies:
(1) the questions of the study; (2) its propositions, if any; (3) its unit(s) of analysis; (4) the logic linking the data to the propositions; and (5) the criteria for interpreting the findings.

According to Gerring (2007), a case study research design may also refer to a work that includes several case studies, for example, comparative-historic analysis or comparative method. Yin (2014) emphasizes that the unit of analysis defines what the case is and that the main unit of analysis is likely to be at the level being addressed by the main study question, which is followed by linking the data to propositions and the criteria for interpreting the findings.

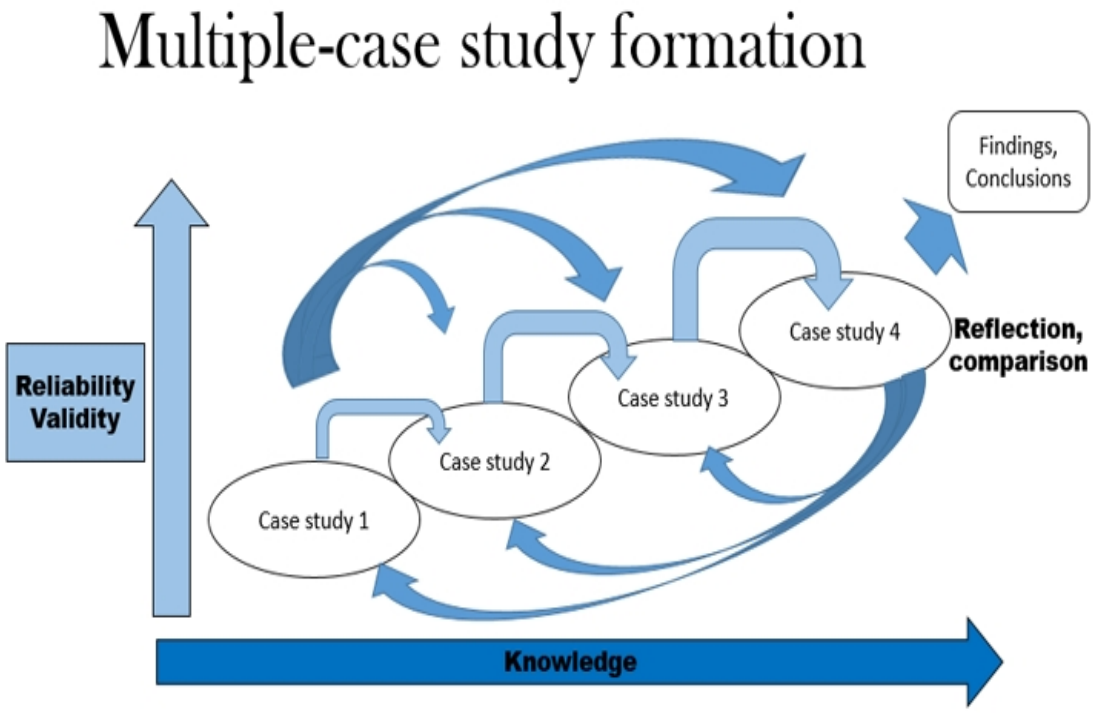

Figure 3. Multiple-case study formation

Figure 3 shows how case studies processes reflect, replicate and iterate to each other. Reliability of the research increases when base of knowledge increases. In this thesis comparison between the case studies create a base of knowledge to design artifacts. By conducting empirical case study strategy is gained a good knowledge about relationship between humans and information systems. Multiple case studies should follow replication logic and selected cases should serve in a manner similar to multiple experiments.

According to Ojasalo, et al. (2009, 52) case study illustrates the attempt to produce a profound and detailed information about the object under research. The case study makes it possible to understand the development of a holistic items in a realistic operational environment. It is more important to find out a lot from a small amount of research objects than little from a large amount of research objects.

3.4 Individual, group and etnographical dimension

According to Hughes et al. (1993) main principle of ethnographic studies is their focus upon the rich and varied "real world" sociality recovered through a fieldworker's participation in the social life of some setting. Directed toward system use and system design, this implies placing an emphasis on studying the functionalities of a technological system as they evolve from their incorporation into the socially organized work activities of those who use them.

The ethnographer's task is to gain access to and knowledge of the social practices, knowledge, beliefs, attitudes and activities, etc., as exhibited by participants in some "natural setting", and to present these in terms of a sociological account of a of life' as organized by its participants (Hughes et al. 1993).

3.5 Data collection

The data collection portion of the protocol needs to accent the major tasks in collecting data. These issues are: Gaining access to key organizations on interviews; having sufficient resources while doing real fieldwork – including a PC, writing instruments, paper etc.; developing a procedure for calling for assistance and guidance, if needed; making a schedule of the data collection activities that are expected to be completed within specified periods of time; and providing for unanticipated events, including in the availability of interviewees as well as changes in your own power while doing fieldwork. (Yin 2014, 89-91.)

There are six sources of evidence for case studies; documentation, archival records, interviews, direct observation, participation-observation and physical artifacts (Yin 2014, 106). It is recommended to use multiple sources of evidence in case study.

The materials collected for this study are based on observations, interviews, scientific publications, collected articles and literary material. One prominent data collecting method used was focus interviews. The focus interviewees were designated based on their expertise on their specialist role. The interviewees operates or have been operated in the public safety. In order to achieve triangulation, data were gathered from multiple sources.

In case study [P1] data was collected from documents, collected articles and printed books. In publication [P2] main data collection were made by interviews and observation. In extended version of [P2], extended journal [P3] data deepens the knowledge acquired from additional literature and collected articles. The fourth case study deals with how real-time video solution can affect creating situational awareness to level of preparedness in situation centers. Question were sent in advance to interviewees. These cases use triangulation of data sources to ensure the credibility and validity of the results.

Participant observation makes it possible to get close to the actors. It illustrated the identities of actors diversity. Observation is made on the field and the results are recorded and saved as notes. In an ethnographic research collecting empirical data requires researcher´s presence. The researcher will participate in group activities, observe and interview the workers. Several different methods can be used in the study, such as interviews, participatory and

non-participatory observation, video and audio recording or photographing a variety of natural situations. (Viinamäki 2007, 113.)

Recorded material certainly provide a more accurate interpretation of any interview than taking your own notes. In these cases, research data was mainly audio and video recorded. In addition the recorded interviews were analyzed with qualitative content analysis methods.

Observations and interviews in real working environment are essential because differences between literature material and real life effects research reliability.

3.6 Data triangulation

The use of multiple sources of evidence in case study research allows a researcher to address a wider range of historical and behavioural issues (Yin 2014).

Usually used four types of triangulation in doing evaluating are; triangulation of data sources, triangulation among different evaluators, triangulation of perspectives and triangulation of methods. (Kananen 2013; Patton 2002; Yin 2014.)

Data triangulation helps to strengthen the construct validity and the multiple sources of evidence essentially provide multiple measures of the same phenomenon. An invaluable advantage of case study research will have been lost without such multiple sources. (Yin 2014, 122.)

4 SUMMARY OF PUBLICATIONS

4.1 Case study 1

The objective of publication [P1] was end user requirements in ambulances in Finland and globally. Paper is presented in Mobi-seminar. Comparison of functional level user requirements brought out that end user requirements have similarities on a high level but also have differences on the lower functional levels end user requirements in Finnish MOBI-project have been compared against the global end user requirements to understand emergency care workers better in general. The compare was made by using NABC Framework (Need, Approach, Benefits and Competition). This comparison brought out that end user requirements have similarities but also have differences on the functional level. When developing the methods of a mobile emergency care work, it is important to recognize and acknowledge the end user requirements that have been globally investigated.

4.2 Case study 2

Publication [P2] Using a Real-time Video to Allocate Public Protection and Disaster Relief Resources in Rescue Service Process. Case: Natural Disaster in the Viksu 2014 Young Firefighters Camp has been presented in 5th European Conference of COMPUTER SCIENCE (ECCS '14) in Geneva, Switzerland in December 2014 to academic audience and published.

The case belongs to the multinational Multi-Agency Cooperation in Cross-border operations (MACICO) project. Macico projects goal is to develop telecommunication solutions that are viable in various complex and demanding public safety incidents. Macico projects goal is to develop telecommunication solutions that are viable in various complex and demanding public safety incidents. Simulation of natural disaster was held in the context of the camp. High security communication platform developed by Ajeco ltd. and EyeSolution´s real-time situational awareness -software for smartphones and C2-systems were tested in connection with the exercise. Tested DSS-solution is shown in figure 4.

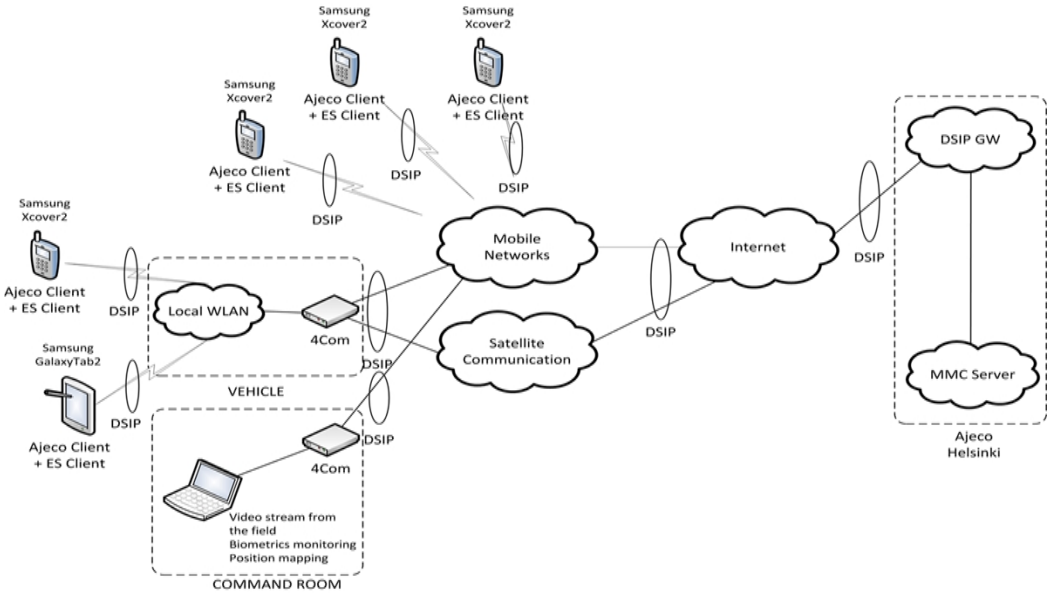

Figure 4. Tested DSS-solution

The result of the study indicate that watching the real-time video tie persons down in the command and control room and they can´t participate in operational action at the same time. Command and control management need more personnel to follow the screens. Importance of overall pictures increases in the beginning of the alarm.

If first responders arrive in 20 minutes, one third of the “golden hour” has been lost. A Camera installed in a PPDR vehicle needs remote control from the command center. Getting the overall picture depend on where the PPDR vehicle is placed at the scene of the accident.

View of an object from above would help notice rescue workers movements and would show variable factors like tents from the whole area. Traditional 3d-maps do not show updated maps enough.

4.3 Case study 3

Publication [P3] How situational awareness can be improved by using a real-time video? Case: simulated natural disaster at the Viksu 2014 camp. Extended journal was sent to the International Journal of systems applications.

This paper belongs to the multinational Multi-Agency Cooperation In Cross-border Operations (MACICO) project. The MACICO project's goal was to develop telecommunication solutions that are viable in various complex and demanding public safety incidents.

The results of the study indicate that different departments has their own situation centers, which means that the same real-time picture has to be available for every organization involved. Situation centers tasks are not clearly defined. There are no precise regulation or indication for the activities of the situation centers. The amount of situation centers affects the distribution of resources, organizing and forming of the situational awareness. A command and control center requires more than one person to manage situational information flow. Currently real-time situational picture from the scene of the accident is rarely distribution to command center. Different Real-time situational solutions are tested in the field, but there is no permanent common real-time situational awareness system, that could be used to enhance situational awareness.

4.4 Case study 4 – proposal

Publication [P4] How a real-time video solution can affect the level of preparedness in situation centers. The publication is sent to The Second International Conference on Computer Science, Computer Engineering, and Social Media (CSCESM2015) that will be held in Lodz, Poland on September 21-23, 2015.

Finnish PPDR authorities and politicians have recognized the importance of a common situational awareness in preparation for the future. When the purpose is to work effectively towards a common goal or solve various challenges, accurate and reliable information as a basis for situational awareness is needed. It is also called as optimal common overall picture. This study was conducted on the ground by visiting situational and command centers located in the Turku area. Police, Fire brigade, Emergency care and the Border Guard have their own situational/ command centres.

5 CONCLUSIONS AND DISCUSSION

5.1 Main results

Real-time video as a part of the decision support system can be utilized in the public sector only if there are technological, human and material resources. Harnessing the power of civil activity and the capacity of mobile devices combined with a centralized real-time situational awareness system could form a decision support system, that would serve effectively all the PPDR authorities in all the situations described. With the help of crowdsourcing useful information can be reached with aid from volunteer associations available. Emergency accommodation or food supply is easier to arrange when supply equals demand. Along with the local situation and command centers this data could be provided to the Finnish Government in the most wide and massive disasters.

In a case of a major accident organizations own tasks help them to concentrate on their own field of PPDR operation. But on the other hand their own tasks prevent them from seeing what the other PPDR authorities are doing. The operational field work of the PPDR authorities should be more standardized so that implementing new technology would be profitable.

When there is a question about optimal common situational picture or situational awareness, much more is required from society and the PPDR authorities in case of a major accident than maintenance of the daily activities. If information does not flow between the regional authorities, it does not reach the central administration either. Problems in the regional level emphasize in cross-border operations. Information should be available for all levels at the same time when it reaches the PPDR authorities of local level. A common situation center in regional level would be an answer to many problems, but overlapping administration should be avoided. New information systems can be implemented only when the operational environment is systematized.

If Finland would be a member of NATO, Finland would have better chances to respond crisis crossing border. Finland would also have better chances to respond to national incidents, because NATO has more developed situational awareness systems.

5.2 Discussion of the research process

Data triangulation of the research helps to strengthen the construct validity and the multiple sources of evidence essentially provide multiple measures of the same phenomenon.

The materials collected for this study are based on observations, interviews, scientific publications, collected articles and literary materials. The contents of the electronic recorded materials have been transcribed. Multiple sources of evidences and methodological triangulation (qualitative and quantitative) enhance the evidence of the research. Comparing the sources of data within and between the publications produces a part of the sufficient evidence. The official reports such as audit reports have been used as references. With comparison of the data sources have been gained reliable results. The findings from the transcribed interviews and the observations from the field [P2] [P4] caused repetition in the gathered data.

The results of the study [P1] have been presented to the PPDR authorities in MOBI-seminar. The author was part of the research group as a student. Representatives of the cooperators were in the audience. The presentation caused constructive discussion and got positive feedback.

Publications [P2]-[P4] have gone through peer review process and the publication [P2] has been presented in the 5th European Conference of COMPUTER SCIENCE (ECCS '14) in Geneva, Switzerland to academic audience by Dr. Jyri Rajamäki and published. The research was conducted by the author and writing were done mainly by the author.

The third publication [P3] was written for a journal and it was based on the second publication [P2]. The author conducted additional research. The publication [P3] has been sent to the International Journal of systems applications.

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Figures

Appendices

Appendix 1: Functional level user requirements for paramedic work in ambulances.

Appendix 2: Using a Real-time Video to Allocate Public Protection and Disaster Relief Resources in Rescue Service Process. Case: Natural Disaster in the Viksu 2014 Young Fire-fighters Camp

Appendix 3: How situational awareness can be improved by using re-al-time video? Case: simulated natural disaster at the Viksu 2014 camp

Appendix 4: How a real-time video solution can affect to the level of preparedness in situation centers?

P[1] M. Daifi, P. Kiiski, M. Viuhko, J.Simola. Functional level user requirements for paramedic work in ambulances: Finland and globally, Paper is presented in MOBI-conference, Espoo, 31.5.2013.

Functional level user requirements for paramedic work in ambulances: Finland and globally

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Abstract: - Medical information systems and databases have developed rapidly in recent years. Progress in mobile technologies has generated a demand to take these functionalities into account on mobile work in ambulances. The ambition to make the most out of the medical information systems in these mobile environments is to take advantage of the capabilities in mobile technologies to make use of the systems remotely. The primary functions for these mobile technologies and systems are to substitute the paperwork, provide interface to search for information and to enter information to the medical information systems while on mobile emergency. Benefits that will be gained from real time patient information updates are the increased quality of the care and more accurate information about the patient's condition during the mobile emergency care. The objective of this paper was end user requirements in ambulances in Finland and globally. This paper does not consider on how the end user requirements are going to be solved. End user requirements in Finnish MOBI-project have been compared against the global end user requirements to understand emergency care workers better in general. The compare was made by using NABC Framework (Need, Approach, Benefits and Competition). This comparison brought out that end user requirements have similarities but also have differences on the functional level. When developing the methods of a mobile emergency care work, it is important to recognize and acknowledge the end user requirements that have been globally investigated. These results can and should be exploited also in standardization of the technology in ambulances.

Key-Words: - End user requirements, Medical information systems, Ambulance, Patient information, Quality, Remote use, Real time.

1 Introduction

In past decades Public Protection and Disaster Relief (PPDR) vehicles have undergone huge changes due to technical evolution of equipment used in the cars. During this time the numbers of technical equipment like voice and data communications, computers, screens, printers, antennas and cablings have increased causing more technical and functional needs to be resolved. Because of these needs and lack of standardized solutions PPDR organizations and others have started to do more research to find solutions that would serve a solid foundation for the standards in emergency vehicles such as police cars, ambulances' and fire trucks. Prompt and accurate communication between paramedics and command center can make the difference between life and death [1].

Finnish national research, development and innovation programme Mobile Object Bus Interaction (MOBI) has started to do research on ICT hardware and software infrastructure for emergency vehicles [7]. MOBI has been divided to smaller Work Packages (WPs) that are presented on Fig. 1. Goal for the program is to develop product concepts' and standards that would serve domestic markets as well as global. This paper focuses on Work Package 2 – "User needs" package and specifically drills into functional level user requirements for paramedic work in ambulances.

#	Name
WP1	Project management
WP2	User needs
WP3	Vehicle ICT infrastructure and power generation
WP4	Data communications
WP5	Common software infrastructure
WP6	ICT services for PPDR practitioners
WP7	Demonstration vehicle
WP8	New business models studied

Fig. 1 Work Packages of MOBI Project

On chapter 2 research methods are illustrated and explained more in detail: How was this research done and what is the objective for it. On chapter 3 all the findings are established more in detail and analyzed in individual level. Chapter 4 compares the findings and highlights similarities and differences' for the conclusion.

2 Research Methods

2.1 Literature Review

Literature review was started by planning the perspective of literature review according MOBI project Work Package 2 (user requirements). It was decided to select perspective of end user requirements in paramedic work in ambulances in Finland and globally.

The research instrument for this study was literature review of MOBI studies that were compared to different studies made about end user requirements in paramedic work in ambulances globally. Source material for this literature review was searched from the Internet.

Literature review was made for all studies found including open label studies and contract research studies. After finding the studies according to end user requirements in paramedic work these were reviewed and the ones chosen for this paper were decided to be mainly from geologically and culturally different kind of countries to find similarities of end user requirements in paramedic work.

2.2 Compare using NABC

Compare was made by using NABC Framework (Need, Approach, Benefits and Competition) [2]. The need in this research was to find end user requirements in paramedic work and to find similarities in different countries if any. The approach was to search from the MOBI projects archives and from the internet research papers, articles and other publications about end user requirements in paramedic work. The benefits part from the NABC was to find the similarities aiming for standardization of the technology in ambulances for paramedic work. Competition was not found in the research area of similarities in end user requirements in paramedic work. Therefore the findings in this paper are unique.

3 Findings

3.1 Australia – Sierra Wireless

St John Ambulance Western Australia has been serving the Western Australia and the Northern Territory for more than 100 years. As a community-based organization, its primary role is to provide first aid training and care for the sick and injured. [5]

User need for St John Ambulance was to run ePCR (Eletronic Patient Care Records) system with iPads in ambulances. ePCR systems are used by Emergency Response Centres (ERC) and paramedics on field. Emergency Response Centre officials are entering incident location, dates and times to ePCR system. When the paramedic arrives at the scene, he or she enters information from patient to system. Information can include paramedic's observations, medical history, allergies and other information which will help the medics and emergency room staff in their work.

Business challenge was to manage more than 850 3G accounts for iPads. Solution for the organization was to deploy Wi-Fi hotspot around each ambulance with Sierra Wireless. This allows paramedics to utilize the Wi-Fi-only iPads as opposed to the more expensive Wi-Fi + 3G version, as well as reduce the number of SIMs required. [5]

Having Wi-Fi connection inside ambulance makes paramedics work easier. Wireless infrastructure inside the vehicle is always similar and they can bring any iPad to ambulance with them.

3.2 Finland - MOBI

In Finland part of MOBI project was conducted research on Physicians' professional use of tablet computers and smartphones [6]. The research objective was to investigate the usage rates and opportunities of mobile devices in healthcare industry in Finland and compared against the findings in USA and Europe. Primary goal was to answer question: "Is the rate of usage growing in Finland?" Research methods used were literature reviews, interviews with healthcare experts and conducting surveys for physicians and doctoral students. The results of the study indicate that the usages of mobile devices are growing in Finland [6]. Smartphone's and tablets are widely used among physicians, but not harnessed in their full potential.

Especially in paramedic work the research did find targets, user requirements and opportunities such as 1) remote access to medicine information and first aid instructions on field, 2) usage of patient information via cloud services and overall and 3) online access to medical data.

3.3 Italy – University of Udine

In Italy a research paper of mobile devices in medical was made in University of Udine has important end user requirements related to health care services in Italy. The research objective was to make a user evaluation of a PDA-based interface for ambulance run reporting Services [3].

This research showed that there were a lot of different services in hospitals therefore it was shown vital for getting real-time information about nearby hospitals and/or medical care facilities, checking their availability and therapeutic capabilities and communicating data to them. It was also shown to be important to enhance operations timeliness by allowing to efficiently record and communicate data between on-site teams and Emergency Response Centres and being able to efficiently perform on-site patient classification using severity color coding (triage), by rapidly applying a set of criteria (triage protocol). There was also one more important user requirement shown about being able to get information from medical databases that could help in choosing a proper course of action in the field [3].

3.4 Ireland / Dubai – Valentia Technologies

Pre-Hospital Emergency Care Council of Ireland (PHECC) and the Dubai Ambulance Centre (DAC) healthcare authorities wanted to identify and find a solution to optimize health care practitioners work during a ”golden hour” after paramedics collect patients. "Golden hour" means that a critically injured patient should be in definitive care within 60 minutes of an injury for optimal survival. Correct pre-hospital emergency care administered before and during transit to hospital affects the clinical outcome following a patient´s arrival in the emergency department. The healthcare authorities also wanted an electronic solution flexible enough to incorporate its existing systems. Further requirements included the ability to undertake detailed analyses and evaluation of standardized data on pre-hospital emergency practice. Additionally they wanted to ensure that the solution´s would be developed ease of use by paramedics to facilitate care delivery during patient transit [4].

Paramedics in Ireland and Dubai have been using traditional paper-based systems in ambulances. Manually recorded patient details and interventions may be based on incomplete or inaccurate data, illegible handwriting or damaged forms. Therefore Pre-Hospital Emergency Care Council in Ireland and Dubai Ambulance Center wanted to replace old paper-based systems to mobile tablet-based solution which works in public mobile networks. Old problematic and slow method was replaced by a new Electronic Patient Reporting System (ePCR system) that offers real-time transmission of in-field patient data to emergency departments. The new system enables to speed up the transmit of a patient data from ambulances for real-time display in hospital emergency department. The units will receive personalized information of patients, which makes it easier to prioritize patients correctly [4].

3 Discussion

Comparison of functional level user requirements brought out that end user requirements have similarities on a high level but also have differences on the lower functional levels.

Similar high level end user requirement for all studies presented on figure 2 were: 1) Communication In-vehicle, 2) Streamline First-aid / patient care, 3) to Replace paper forms used by paramedics, 4) Improved access to information (patient, medical and hospital) and 5) Input data while in-transit.

High Level end user requirements	Valentia Technologies	Sierra Wireless	University of Udine	MOBI
Communication In-vehicle		1	1	
Streamline First-aid / patient care	2	2	2	2
Replace paper forms used by	3	3	3	
Improved access to information (patient, medical, hospital)	4	4	4	4
Input data while in-transit (patient)	5	5		

Fig 2 – High level end user requirements

On a lower level end user requirements started to differ more (presented on figure 3). Organizations and end users did have the same needs for example streamline First-aid and patient care, but the underlying approaches were different due to the maturity of medical industry in different countries and organizations. In Australia the approach was simply to optimize patient first-aid and patient care with in-vehicle communication solution, replace paper forms used by paramedics, improved access to

patient information and input critical data while in-transit. In Dubai on the other hand approach was to provide real-time patient data transformation solution between ambulances and hospitals, to give visibility on inbound patients prior to arrival. In Italy getting real-time information about nearby hospitals and/or medical care facilities, checking their availability and therapeutic capabilities, and communicating data to them. This perspective did not show up in other studies.

1 - 5 = High Level Requirement

A - E = Low Level Requirement

High and low level end user requirements	Valentia Technologies	Sierra Wireless	University of Udine	MOBI
Communication In-vehicle		1	1	
In-vehicle communication solution		A		
Improve communication between paramedics and HQ's - speed & reliability			A	
Streamline First-aid / patient care	2	2	2	2
Streamline First-aid / patient care		B		
Efficiently perform on-site patient clasification			B	
Real-time information about nearby hospitals			B	
Real-time transmission of patient data from ambulance to hospitals	B			
Visibility on inbound patients prior to arrival	B			
Data immediately available to other healtcare professionals	B			
Real-time transmission of patient data from ambulance to hospitals			B	
Access to drug information and first-aid instructions (online)				B
Replace paper forms used by paramedics	3	3	3	
Replace paper forms used by paramedics		C		
Relieve burden of paper records	C			
Replace paper forms used by paramedics			C	
Improve recording (patient data) methods to be more secure			C	
Improved access to information (patient, medical, hospital)	4	4	4	4
Improved access to patient information		D		
Find and organise information	D			
Online access to medical data				D
Use of patient information from cloud				D
Using information from medical databases			D	
Real-time transmission of patient data from ambulance to hospitals	D			
Visibility on inbound patients prior to arrival	D			
Data immediately available to other healtcare professionals	D			
Real-time transmission of patient data from ambulance to hospitals			D	
Access to drug information and first-aid instructions (online)				D
Input data while in-transit (patient)	5	5		
Input critical data while in-transit		E		
Real-time transmission of patient data from ambulance to hospitals	E			

Fig 3 – High and low level end user requirements

4 Conclusion

In research of the end-users functional needs and solutions for the standardization it is very important to consider the research of lower-level differences in end-user needs. On the high level user requirements might correspond to each other, but on the lower level, they differ considerably. It is essential to take into account the lower-level end users functional needs when creating the solutions and standards to serve the widest possible user base in the organization and not depending on the geographic location. Due to these findings it is recommended to do more detailed research on the functional end user requirements in order to create better solutions and standards for paramedic work in ambulances.

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Using a Real-time Video to Allocate Public Protection and Disaster Relief Resources in Rescue Service Process. Case: Natural Disaster in the Viksu 2014 Young Firefighters Camp

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Abstract: - The simulated natural disaster was performed on the Viksu 2014 young firefighters camp area in Pori, Finland. It is said that "one picture is worth a thousand words" – But how rescue services operational decision-making processes can be enhanced? It is a crucial issue in this matter because Public Protection and Disaster Relief (PPDR) services such as the fire brigade with volunteer firefighters and emergency medical services (EMS) are tasked with the challenge of providing the first response in life critical circumstances. The objective of this case study was to research the added value of real-time video in simulated natural disaster and compare the results with different user-needs. EyeSolution´s real-time situational awareness software for smartphones and command and control systems were tested in connection with the exercise. The material of this case study was gathered by literature reviews, interviews and observation in the field during the Viksu 2014 camp. The results can be summarized that real-time situational awareness solution enhanced different PPDR actors work in during the accident but usability and technological innovations must move in the same direction.

Key-words: - Public safety, disaster relief, first responder, smartphone, natural disaster, command and control management, situational awareness

1 Introduction

The simulated natural disaster was performed on the Viksu 2014 young firefighters camp [1] camp area in Pori. The Viksu 2014 young firefighters camp was an international youth camp, where young voluntary firefighters met and practiced rescue skills.

Laurea University of Applied Sciences, Laurea's university students, Ajeco ltd., Airbus defence and space ltd. and Eye Solutions ltd. participated on the camp where rescue exercise was based on a downburst hitting the camp. Laurea's partners Ajeco and Eye Solutions provided a field operation platform with various telecommunication possibilities for the Viksu 2014 camp. The first responder is usually the first person to arrive on the scene that is trained to provide a higher level of care.

First responders are often the first people at the scene of an emergency. They may be fire fighters, border guards, or people with similar responsibility for the safety or well-being of the community.

The first hour after the onset of out-of-hospital traumatic injury is referred to as the "golden hour". Patients who are in the operating room within one hour of injury have a much higher survival rate [2]. This is one example, why quickly offered and reliable situational awareness and real-time picture is necessary for emergency responders and decision makers.

The case belongs to the multinational Multi-Agency Cooperation in Cross-border operations (MACICO) project [3]. The MACICO project's goal is to develop telecommunication solutions that are viable in various complex and demanding public safety incidents. The MACICO project's goal is to develop telecommunication solutions that are viable in various complex and demanding public safety incidents.

The objective of this case study is to research the added value of real-time video in simulated natural disaster and compare the results with different user-needs. The aim was also to find out what kind of added value used a situational awareness communication model brings to all public protection and disaster relief authorities.

After this introduction, Section 2 provides the theoretical foundation of the case study. Section 3

presents the applied methods and research process of this case study, Section 4 the empirical target and Section 5 the technical solutions that are used in the Viksu 2014 camp. Section 6 gives an analysis of the case study findings including the different user needs concerning rescue personnel groups on the camp. Finally, Section 7 discusses what kind of benefits situational awareness model brings to different actors.

2 Theoretical Framework

2.1 Overview of Public Protection and Disaster Relief Functions

The term 'public protection and Disaster Relief' (PPDR) is used to describe critical public services that have been created to provide primary law enforcement, firefighting, emergency medical services and disaster recovery services for the citizens of the political sub-division of each country. These individuals help to ensure the protection and preservation of life and property. Public safety organizations are responsible for the prevention of and protection from events that could endanger the safety of the general public [4]. Such events could be natural or man-made. According to [4], the main public safety functions include law enforcement, emergency medical services, border security, protection of the environment, fire-fighting, search and rescue and crisis management.

One major challenge in defining a classification of public safety organizations at the European level is that, due to the non-homogenous historical development of public safety, similar organizations have different roles in different countries [4]. A certified first responder is a person who has completed a first aid course and received certification in providing pre-hospital care for medical emergencies. The majority of public safety organizations' personnel are also certified first responders.

2.2 Reliable Data Communications

Modern societies rely highly upon reliable data communication. Information is an invaluable asset.

Reliable methods for transporting information are crucial. A constantly increasing amount of critical systems in a modern society are being remotely controlled and monitored. For example, but not limited to, the increasing need for remote control in power utility and grid applications, security surveillance, secure transactions in the commercial sector, and so on. The word "reliable" must be understood by its widest interpretation – reliable does not only refer to technical reliability, it refers to general trustworthiness, information security, and non-repudiation, as in providing proof of data integrity and origin, including authentication with a high assurance of being genuine.

Satellite communications is making an increasingly important contribution to the security of Europe. European citizens are constantly facing security threats that are now more diverse, less visible and less predictable than in previous decades. Europe therefore needs to have access to the best affordable capabilities for the effective conduct of its actions. Satellite communications provides a significant contribution to overcome these threats.

2.3 Command & Control Systems

Most new digital services for the PPDR sector are supplied via stand-alone systems without built-in interoperability. There is a real lack of a coherent system that would coordinate the various technologies and improves the system's accuracy and usability. According to Frost's and Sullivan's study [5], the need for interoperability between services is the key market driver with regard to first responders' communications, command and control and the intelligence (C3I) market. The main market restraints are fragmented decision-making and budgetary allocations [5](Srimoolanathan 2012), as illustrated in Fig. 1.

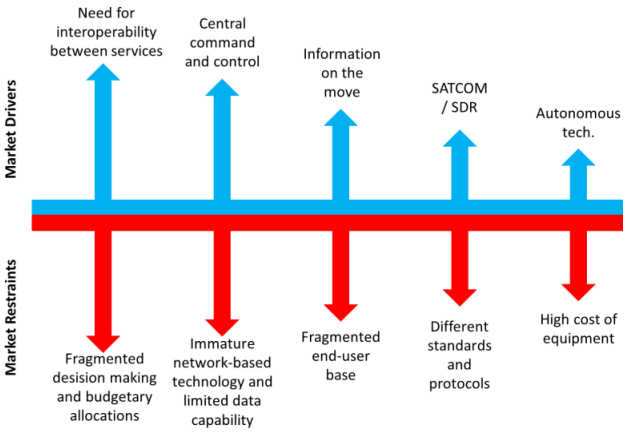

Fig. 1 Key market drivers and restraints of first responders' communications, command and control and intelligence market

Remote operation means the control and operation of a system or equipment from a remote location. In systems engineering, monitoring means a process within a distributed system for collecting and storing state data. A PPDR monitoring station is

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a workstation or place in which sensor information accumulates for end-users who need it. Monitoring systems include information collection, analysis and provision for end-users, which is front-deployed-knowledge.

2.4 Video Surveillance

Video surveillance has been used in many public events for years and there is a large variety of products available. Video surveillance cameras are often categorized by their viewing direction, which means that the cameras are either fixed (a camera that has a fixed viewing direction once it's mounted) or panoramic cameras (they provide a 360 degree field of view). Older generation video surveillance systems are usually focused, meaning that they provide a view to a single direction. Newer cameras are often panoramic, meaning that they can provide a view of 180 or 360 degrees and they also provide better quality, most often 720p or 1080i. Some camera models also provide more advanced features, such as motion detection, audio detection and tampering alarm [6].

Often the cameras are fixed, but for example a mobile video surveillance system that could easily be moved around the venue could be beneficial in larger public events. One of these mobile surveillance units is Pro-Vigil's Virtual Guard Station. There are a number of companies that provide similar mobile surveillance applications in the market; however, most of the companies in the business are located outside Finland. Examples of such applications include Wireless CCTV and Axis Communications.

3 Research Method and Process

Yin [7] identifies five components of research design for case studies: (1) the questions of the study; (2) its propositions, if any; (3) its unit(s) of analysis; (4) the logic linking the data to the propositions; and (5) the criteria for interpreting the findings. According to Gerring [8], a case study research design may also refer to a work that includes several case studies, for example, comparative-historic analysis or comparative method. Yin [7] emphasizes that the unit of analysis defines what the case is and that the main unit of analysis is likely to be at the level being addressed by the main study question, which is followed by linking the data to propositions and the criteria for interpreting the findings.

The research data of this case study were gathered by interviews, observation in the field and literature reviews. During the research process there was interaction and discussion between the researcher and the rescue workers. Observing users in the field give the better way to understand usability requirements. In addition the interviews were recorded and analyzed with qualitative content analysis methods [9].

4 Empirical Target

The capabilities of PPDR organizations across Europe have been considerably improved with the deployment of new technologies including dedicated TETRA (Terrestrial Trunked Radio) and Tetrapol networks [3]. Security organizations increasingly face interoperability issues at all levels (technical, operational and human) as they interact with other national, regional or international organizations. PPDR organizations have to benefit from interoperability functions in their day-to-day work [3]. The MACICO project aims at developing a concept for interworking of security organizations in their daily activity. The main goal of the MACICO project is to address on a short-term perspective, the needs for better systems, tools and equipment for radio communication in cross-border operations [3]. The main key is to concentrate on an operation which takes place on the territory of other member states. One example of above mentioned situation is a high scale civil crisis operations or complex emergencies where the authorities need support of public safety services from other member states.

The MACICO project is a Celtic-Plus project with nine project consortium partners from Finland, France and Spain. The project started at December 2011 and its duration was 30 months. However, the Finnish consortium continues until the end of the year 2014, because of all the demonstration during Viksu camp and the analysis of them [10]. Target of the project is to develop a new interworking concept for security organizations which do not use the same communication network in their daily basis, but they could take a benefit from sharing their respective network infrastructure. The way to organize cross border use of the communication networks will be defined and validated by the security organizations authorities. Use cases such as pursuit of criminals across the border, close support of vehicles going through a border and disaster relief operations require security organizations from both countries to communicate together and to communicate with their control room. Technically these use cases needs options like inter-network communication, coverage expansion and migration [3].

The MACICO project'smain objective to provide full interoperability between different TETRA and Tetrapol networks has been achieved. With the achieved technical solutions the following networks can be connected: TETRA-TETRA, TETRA-Tetrapol, Tetrapol-Tetrapol. This comes at the right time as there is today increasing pressure from the governments that this cooperation happens. The consortium is however conscious that the public safety actors (firemen and police, among others) do not like to share their resources (including their networks) and there is work ahead to convince them to adopt this new way of working; for example, further discussions would be needed to ensure data interoperability, a topic that was outside the MACICO project's responsibility but should be tackled to ensure real cooperation between security teams. An important aspect is also that the MACICO solution allows migration from an older to a more recent solution without interrupting the services. This opens new opportunities, for example, in the promising transition to Long Term Evolution (LTE) / 4G networks. Also, the importance of the satellite communication (SATCOM) during emergency situations, identify the associated challenges and call for concrete actions to overcome them is highlighted.

5 Technical Solutions

Eye Solutions real-time video transfer solutions with wearable mobile video software product enables distributing multiple simultaneous videos between users. The platform consists of features for bandwidth management, real-time continuous video and audio shared across the team. The system was gathering live audio and video view from the field to the camp security management using cameras and microphones of ordinary modern smartphones. The system consists of a PC which was used to administrate the system, some screens to monitor the situation, Android smartphones to gather the live information from the field and a multi-channel DSiP router. The java based system administration software used browser as an operating system and was run local in a PC. The smartphones can be remotely controlled by the administration software. Using a multi-channel router means, for example, that if a smartphone is outside the WiFi coverage area it switches smoothly to 3G.

Ajeco is the creator and inventor of a patented communications architecture named DSiP – Distributed Systems intercommunication Protocol (R) ™, or in short DSiP. The architecture is realized as a software suite consisting of node-, virtual-router-, control- and monitoring utilities. The DSiP system solution has been developed during the past 14 years, and it is used among several critical applications with operational status.

The camp was equipped with 4Com routers, solution for secure and reliable multichannel communication by implementing the DSiP protocol. The DSiP solution is network- and technology agnostic in the sense that it is able to route data between network peers, regardless of the used physical means of transport. TETRA-, Satellite-, Mobile data-, LAN-technologies, for example, may all be used as parallel communications methods between network peers, however in such a way that the peers will not detect, or see, the different physical transport channels, regardless of link-performance and latencies, of course. DSiP solution can utilize all existing telecom networks such as 4G (LTE), 3G/EDGE/GPRS, Satellite and TETRA and they appear as a single robust and secure data transfer path between the peers. The 4Com routers were installed to the command center and also to one fire truck together with PC with Eye Solutions application.

Situational awareness system of Eye Solutions and reliable communication through Ajeco's 4Com router were tested in the camp. They were also

Fig. 2 Smartphone installation on fireman's uniform

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available during the scenario exercise. In the Viksu 2014 camp, Samsung Xcover Android smartphones were used. Their installations on the rescue workers uniforms were made so that smartphones' cameras could take real-time video (see Fig. 2 and Fig. 3). One mobile command and control system was installed on the dashboard of a fire truck, as shown in Fig. 4. Within the "natural disaster" there were one to three observers in the command and control management room (see Fig. 5). Real-time picture was seen on the screens in the command and control room. Operations in the control room were recorded and analyzed.

Fig. 3 Smartphone installation on paramedic's uniform

Fig. 4 Smartphone installation on fire truck

Fig. 5 Viksu 2014 camp's command and control room

6 Case Study Findings

As a result of literature review and interviews, we selected the following three features with regard to video/camera as being the subject of further analysis: (1) need for controlling the camera remotely, (2) need to share real-time video between actors, and (3) camera features; water-proof, shock-proof, freeze-proof, warm-proof. Table I present the specific end-user needs of these three features. Table II shows the technical possibilities of applied solutions with regard to the selected three features.

TABLE I. Specific user needs (sale 0 – 3)

Role	Need to control camera remotely	Need to share real-time continuous video between actors	Camera features; Water-proof, shock-proof, freeze-proof, warm-proof
Fire/rescue	0	2	3
Paramedics	0	3	1
Command and Control	3	3	0

TABLE II. Technical possibilities (sale 0 – 3)

	Remote control	Real-time continuous video	Camera features; Water-proof, shock-proof, freeze-proof, warm-proof
Eye-solutions situational awareness - model	1	3	1

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Other analyzed features were tracking, maps and reliability. Tables III and IV show our case study results of these analyses.

The critical decision making required in disaster situations is heavily based on the availability, accuracy, and timeliness of information that can be made available to the decision makers.

Importance of overall situation pictures increases in the beginning of the alarm. If first responders arrive in 20 minutes, one third of the "golden hour" has been lost. Therefore, it is not always enough that the patient is rushed to the hospital, but survival may be conditional that the treatment is started already on the field.

Incidents requiring response are matched with available resources. If the total demand is greater than the PPDR organization´s capacity to respond, decision-makers must establish priorities for response in large-scale disaster. Delivered real-time picture allows command and control management to allocate resources in the right proportion.

The result of the case study indicates that watching the real-time video tie persons down in the command and control room and they can´t participate in operational action at the same time. Command and control management needs more personnel to follow the screens. First vital report without real-time video complicates the allocation of resources. Therefore, for example, the (temporary) command and control management team in hospital needs the ability to see real-time picture.

A Camera installed in a PPDR vehicle needs remote control from the command center. Getting the overall picture depend on where the PPDR vehicle is placed at the scene of the accident.

View of an object from above would help command and control personnel noticed rescue workers movements and would show variable factors like tents from the whole area. Traditional 3d-maps do not show updated map enough.

Responders are usually carrying their own smartphones in the field. Used solutions enable PPDR officials and partners to deploy the Android app easily. This allows first responders to use their own smartphones for emergency communications in situations where communications become difficult or jams completely.

TABLE III. Spesific user needs (scale 0-3)

Role	Need of vehicle / personal tracking	Need to see updated maps	Need for reliable data connection	Total points
Fire/rescue	2	1	3	**11**
Paramedics	2	1	3	**10**
Command and Control	3	3	3	**15**

TABLE IV Technical possibilities (scale 0-3)

	Tracking	Maps	Reliability	
Eye-solutions situational awareness - model	3	1	3	**12**

7 Discussion

The case study findings can be summarized so that the used technology is useful. Having the right piece of information at the right time can literally save lives, money and resources.

The applied real-time situational awareness solution enhanced different PPDR actors to do their duties during the accident. However, usability and technological innovations must move to the same direction. A correct and reliable situational awareness solution will require an understanding of what are the real user-needs. Technical solutions are not essential if they are not useful.

In the future, it would be important to investigate real-time situational awareness solutions with micro air vehicles (MAVs) [11]. A remotely piloted or programmed MAV could bring the necessary added value for emergency and rescue services. It can be concluded that PPDR actors over the Western Europe are waiting for common operating model for decision makers.

However, all PPDR ICT solutions need critical communications systems. There is a growing dependence and interest of military and civilian security actors on satellite communications not only during crisis and disaster, but also in every-day routine. It is a unique capability ensuring long-distance communications and broadcasting. It facilitates the use of mobile or deployable platforms as a substitute or support for ground-based communication infrastructures and to cater for the exchange of large quantities of data. Satellite communications is often the only possibility for public protection and disaster relief to communicate when they have to intervene in distant areas where the ground infrastructure is damaged or destroyed, using mobile or deployable systems.

A very important factor in critical communications systems, in addition to reliability and security, is a concept called Common

Information Sharing Environment, or in short CISE. In addition to providing multichannel communication, non-reputability, encryption, and security, the DSiP architecture provides means for solving complex compatibility issues providing interface and process ontology and methods.

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How situational awareness can be improved by using real-time video? Case: simulated natural disaster at the Viksu 2014 camp

Jussi Simola, Esa Jokinen and Jyri Rajamäki

***Abstract*—**Public safety authorities all over the world have recognized that the lack of interoperability of information and communication technology (ICT) systems limits the effectiveness of rescue operations. Whether natural or man-made, catastrophes can happen at any time, and with no warning. This creates major problems for public safety agencies set up by governments to provide for public protection and disaster relief (PPDR). The ability of these agencies to cope with unexpected disasters and emergencies of any scale is dependent upon the infrastructure and support that they have in place for their day-to-day operations. Need of overall situational awareness has increased during the past decades. Research data of this case study consists of a literature review, interviews, on-field observations and discussions during an exercise, where a technology providing live video was tested during simulated natural disaster at the Viksu 2014 Young Firefighters Camp. The results of the study indicate that watching real-time video ties persons down and they cannot participate in operational action at the same time. Different departments has their own situation centers, which means that the same real-time picture has to be available for every organization involved. The amount of situation centers affects the distribution of resources, organizing and forming of the situational awareness. A command center requires more than one person to manage situational information flow. Responders are usually carrying their own smartphones on the field. Used solutions enable PPDR officials and partners install and deploy applications easily. Applications might allow first responders to use their own smartphones for emergency communications in situations where communication with primary network becomes difficult. Decision-makers must establish priorities for response in large-scale disaster when the total demand for rescue services is greater than the PPDR organization´s capacity to respond. Distributed real-time video improves decision support systems by allowing command center to allocate resources in the right proportion.

***Keywords*—**public safety, command and control management, decision support systems, real-time video, situational awareness

I. Introduction

THERE has been unexpected disasters e.g. a major earthquake in South Asia, a shocking tsunami in the Indian Ocean, flooding and forest fires in Europe. Also disasters due to human activities, such as terrorist attacks or industrial accidents, happen all too frequently around the world and threat of military presence is rising. It has been seen that a military threat in Eastern Europe has come back as crisis in Ukraine have raised military tensions.

A human is still the decision-maker at the scene of the accident, although different kind of decision support systems have become a part of decision-making. Rescue manager makes the decision based on gathered information. View of the situational awareness is inevitably partly subjective. Therefore, more accurate situational picture makes the conditions less ambiguous. Situational centers allocate resources based on the situational picture. Decision-makers share information of the accident from the command or situational center to the rescue workers on the field.

Therefore, organizational structures are significant when evaluating the advantages of the decision support systems. If organizational structures are incompatible or complex, sharing the right information to the correct authorities becomes more difficult. The information available must correspond to the required knowledge. In a case of a disaster there might be a need for emergency accommodation or food supply, but different authorities do not receive information on available aid from volunteer associations. According to Rajamäki et al. [1] and Hanni [2], there is a need to ease situational awareness and decision making by using cameras and sensor information.

Singular decision support tool does not integrate all the information systems used by involved organizations. There is also still confidential information that must be kept within one authority. Likewise, there is information that is publicly available for everyone but does not reach the authorities. Whether the situation is caused by human activities or natural disaster, it can expand to larger areas and even cross-border. This emphasizes the meaning of both co-operation between situation centers and compatibility of the information and communication systems. Sharing resources also involves the availability of required services and their usability. Expanding operational cooperation aims practical co-operation and mutual interaction between public safety actors, which will improve the situational awareness [3].

In this study, situational awareness was studied by evaluating new technologies during a simulated natural

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Fig. 1 Natural disaster rehearsal.

disaster that was performed at the Viksu 2014 [4] camp area in Pori, Finland. The Viksu 2014 Young Firefighters Camp was an international youth camp, where young voluntary firefighters met and practiced rescue skills. Laurea University of Applied Sciences, Laurea UAS's students, Ajeco ltd., Airbus defence and space ltd. and Eye Solutions ltd. participated on the camp where rescue exercise was based on a downburst hitting the camp (Fig.1). Laurea's partners Ajeco and Eye Solutions provided a field operation platform with various telecommunication possibilities for the Viksu 2014 camp.

First responders are often the first people at the scene of an emergency. They may be fire fighters, border guards, or people with similar responsibility for the safety or well-being of the community. Although criticized of its dogmatism [5], the first hour after the onset of out-of-hospital traumatic injury is commonly referred to as the "Golden Hour". Patients who are in the operating room within one hour of injury have a much higher survival rate [6]. This is one example, why quickly offered and reliable situational awareness and real-time picture is necessary for emergency responders and decision makers.

The case belongs to the multinational Multi-Agency Cooperation In Cross-border Operations (MACICO) project [7, 8]. The MACICO project's goal is to develop telecommunication solutions that are viable in various complex and demanding public safety incidents.

The objective of this case study is to research the added value of real-time video in simulated natural disaster and compare the results with different user needs. The aim was also to find out what kind of added value used a situational awareness communication model brings to all public protection and disaster relief authorities.

The paper is structured as follows: after introduction we describe the theoretical framework, which consist of similar technologies and the used terminology, followed by more detailed description of the MACICO projects empirical target and technologies developed within the project. Then we explain the applied methods and the research project and the results collected during evaluating these technologies. Finally, discussions section reflects on what kind of benefits situational awareness model brings to different actors and how it could be utilized in new ways.

II. Theoretical Framework

A. *Public Protection and Disaster Relief Functions*

The term 'public protection and Disaster Relief' (PPDR) is used to describe critical public services that have been created to provide primary law enforcement, firefighting, emergency medical services and disaster recovery services for the citizens of the political sub-division of each country. These individuals help to ensure the protection and preservation of life and property. Public safety organizations are responsible for the prevention of and protection from events that could endanger the safety of the general public [9]. Such events could be natural or man-made. According to [9], the main public safety functions include law enforcement, emergency medical services, border security, protection of the environment, fire-fighting, search and rescue and crisis management.

One major challenge in defining a classification of public safety organizations at the European level is that, due to the non-homogenous historical development of public safety, similar organizations have different roles in different countries [9]. A certified first responder is a person who has completed a first aid course and received certification in providing pre-hospital care for medical emergencies. The majority of public safety organizations' personnel are also certified first responders.

Second big challenge relates to structure of organizations. Emergency response center administration has six regional emergency response centers. Different departments has their own situation centers. Situation centers tasks are not clearly defined. There are no precise regulation or indication for the activities of the situation centers [10]. For example in Southwestern Finland Police Departments' situation/command center answers to reporters calls 24 hours per day [11]. The Emergency Response Centre Administration provides emergency response center services throughout Finland. The duty of the Emergency Response Centre Administration is to receive emergency calls from all over the country for the

rescue, police and social and health services; handle communications relating to the safety of people, property and the environment; and relay the information they receive to the appropriate assisting authorities or partners.

Currently real-time situational picture from the scene of the accident is rarely distribution to command center. Real-time situational pictures are tested in the field, but there is no permanent common real-time situational awareness system, that could be used to enhance situational awareness [12-14]. For example fire brigade and police have been using different camera-solutions at occasional situations, but there is no proper real-time situational awareness system in use.

B. Decision support systems for PPDR

Decision-support systems are used to track key incidents and the progress of responding units, to optimize response activities and resources, and to act as a mechanism for queuing ongoing incidents. Each aspect of the above process is part of an ongoing cycle, in which assessments, decisions, and interventions at one point in time produce implications for subsequent response activities [15].

1) Situational awareness in this context

An important factor for using live-video technology in emergency response work is the ongoing trend to improve situation awareness. In this context situational awareness means the ability to have a sense of control of what is going on and what might happen in the future and its implications on operative and strategic levels to allocate public protection and disaster relief resources.

2) Command & Control Systems

Most new digital services for the PPDR sector are supplied via stand-alone systems without built-in interoperability. There is a real lack of a coherent system that would coordinate the various technologies and improves the system's accuracy and usability. According to Frost's and Sullivan's study, the need for interoperability between services is the key market driver with regard to first responders' communications, command and control and the intelligence (C3I) market [16]. The main market restraints are fragmented decision-making and budgetary allocations [16], as illustrated in Fig. 2.

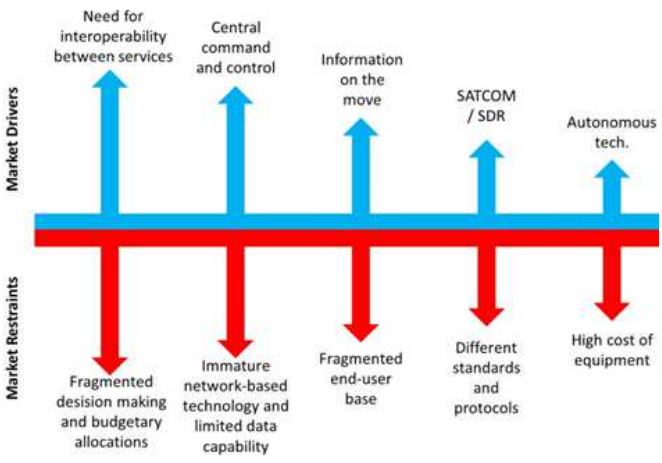

Fig. 2 Key market drivers and restraints of first responder´s communications, command and control and intelligence market.

Remote operation means the control and operation of a system or equipment from a remote location. In systems engineering, monitoring means a process within a distributed system for collecting and storing state data. A PPDR monitoring station is a workstation or place in which sensor information accumulates for end-users who need it. Monitoring systems include information collection, analysis and provision for end-users, which is front-deployed knowledge.

For example most important data system for Finnish police field operations is the POKE field command system. It consists of different kinds of maps, including aerial photos, patrol tracking, messaging, activity logs and information sharing. The system has access and enquiry facilities to various databases, and it includes resource management and dispatching as well as reporting applications .KEJO project means that Ministry of the Interior's ICT Agency HALTIK and the National Police Board are developing a common Field Command System for all public safety actors, because the main need is a common field- command system for all PPDR actors. [17]

3) Video Surveillance

Video surveillance has been used in many public events for years and there is a large variety of products available. Video surveillance cameras are often categorized by their viewing direction, which means that the cameras are either fixed (a camera that has a fixed viewing direction once it's mounted) or panoramic cameras (they provide a 360 degree field of view). Older generation video surveillance systems are usually focused, meaning that they provide a view to a single direction. Newer cameras are often panoramic, meaning that they can provide a view of 180 or 360 degrees and they also provide better quality, most often 720p or 1080i. Some camera models also provide more advanced features, such as motion detection, audio detection and tampering alarm [18].

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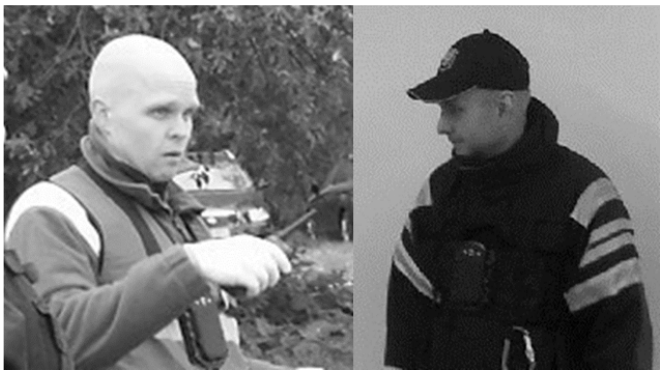

Fig. 3 Smartphone installation on paramedic's (left) and fireman's uniform.

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Fig. 4 Smartphone installation on fire truck. (Photo courtesy of Tapio Mäkinen.)

the camp. They were also available during the scenario exercise. In the Viksu 2014 camp, Samsung Xcover Android smartphones were used. Their installations on the rescue workers uniforms were made so that smartphones' cameras could take real-time video. One mobile command and control system was installed on the dashboard of a fire truck, as shown in Fig. 4. Within the "natural disaster" there were one to three observers in the command and control management room (see Fig. 5). Real-time picture was seen on the screens in the command and control room. Operations in the control room were recorded and analyzed.

V. Research Method and Process

Yin [19] identifies five components of research design for case studies: (1) the questions of the study; (2) its propositions, if any; (3) its unit(s) of analysis; (4) the logic linking the data to the propositions; and (5) the criteria for interpreting the findings. According to Gerring [20], a case study and research design may also refer to a work that includes several case studies, for example, comparative-historic analysis or comparative method. Yin [19] emphasizes that the unit of analysis defines what the case is and that the main unit of analysis is likely to be at the level being addressed by the main study question, which is followed by linking the data to propositions and the criteria for interpreting the findings.

Fig. 5 Viksu 2014 camp's command and control room.

The research data of this case study were gathered by interviews, observation in the field and literature reviews. During the research process there was interaction and discussion between the researcher and the rescue workers. Observing users in the field give the better way to understand usability requirements. In addition the interviews were recorded and analyzed with qualitative content analysis methods [21].

VI. Case Study Findings

As a result of literature review and interviews, we selected the following six features with regard to video/camera as being the subject of further analysis: (1) need for controlling the camera remotely, (2) need to share real-time video between actors, (3) camera features; water-proof, shockproof, freeze-proof, warm-proof, (4) Need of vehicle/personal tracking, (5) Need to see updated maps, (6) Need for reliable data connection.

TABLE I Specific user needs (scale 0–3)

Role	Need to control camera remotely	Need to share real-time continuous video between actors	Camera features; Water-proof, shock-proof, freeze-proof, warm-proof
Fire/rescue	0	2	3
Paramedics	0	3	1
Command and Control	3	3	0

TABLE II. Technical possibilities (scale 0–3)

	Remote control	Real-time continuous video	Camera features; Water-proof, shock-proof, freeze-proof, warm-proof
Eye-solutions situational awareness model	1	3	1

TABLE III. Specific user needs (scale 0–3)

Role	Need of vehicle / personal tracking	Need to see updated maps	Need for reliable data connection	Total points
Fire/rescue	2	1	3	**11**
Paramedics	2	1	3	**10**
Command and Control	3	3	3	**15**

TABLE IV. Technical possibilities (scale 0–3)

	Tracking	Maps	Reliability	
Eye-solutions situational awareness model	3	1	3	**12**

Table I and III presents the specific end-user needs of these six features. Table II and IV shows the technical possibilities of applied solutions with regard to the selected six features.

The critical decision making required in disaster situations is heavily based on the availability, accuracy, and timeliness of information that can be made available to the decision makers.

Importance of overall situation pictures increases in the beginning of the alarm. If first responders arrive in 20 minutes, one third of the "golden hour" has been lost. Therefore, it is not always enough that the patient is rushed to the hospital, but survival may be conditional that the treatment is started already on the field.

Incidents requiring response are matched with available resources. If the total demand is greater than the PPDR organization´s capacity to respond, decision-makers must establish priorities for response in large-scale disaster. Distributed real-time picture allows command and control management to allocate resources in the right proportion.

The result of the case study indicates that watching the real-time video tie persons down in the command and control room and they can´t participate in operational action at the same time. Command and control management needs more personnel to follow the screens. First vital report without real-time video complicates the allocation of resources. Therefore, for example, the (temporary) command and control management team in hospital needs the ability to see real-time picture.

A Camera installed in a PPDR vehicle needs remote control from the command center. Getting the overall picture depend on where the PPDR vehicle is placed at the scene of the accident.

View of an object from above would help command and control personnel noticed rescue workers movements and would show variable factors like tents from the whole area.

Different departments has their own situation centers, which means that the same real-time picture has to be available for every organization involved. The amount of situation centers affects the distribution of resources, organizing and forming of the situational awareness. The live video from the scene only provides more value if it expands the knowledge of the accident and the damages it has caused from the conception formed by verbal description.

Since recognizing an acute crisis from a usual routine assignments is based on situational assessment which is based on the available information, the information has to be relevant, as accurate as possible and timely in order to be useful for distributing resources. Other challenge is the communication systems currently in use: how a system providing real-time video can be implemented or concurrently fit with the VIRVE radio network devices currently in use by Finnish authorities.

Monitoring the real-time video footage cannot, however, delay the help to arrive to the scene by binding operative workers. A person involved with the operational actions cannot observe the video. Therefore, the tasks has to be assigned clearly and the operational work must be separated from gaining the situation awareness and from making decisions. In order to make reasonable decisions the accurate information must be formed quickly: for example the person in charge of a rescue operation must be able to make decisions of a need for a helicopter or even forming a field hospital.

In order to help forming situational awareness the real-time video must be in a useful visual form. It is necessary that the development of the situation can be observed and the spatial placement of the video sources is understood correctly. Possibility to delegate the usable video and other situational information to co-operatives is essential. When it comes to sharing resources in correct proportions for the situation, both operating models and information systems of the organizations involved must be compatible.

Command or situation center can benefit most from real-time video if the picture is sharp and it is shown on an up-to-date map or aerial view. The system demonstrated at the Viksu camp had aerial view with pictures taken approximately one year ago. As observed, the view was already different from the actual landscape and the temporary buildings like the tents complicated forming the correct picture even further. The environment can change within hours, particularly during natural disasters. It is important that the pictures from a camera held by an operative is placed on correct background. Best solution could be picture-in-picture: the captured live videos on a recent and updated aerial view taken within the last minutes.

This solution of live video on current aerial view from the scene would help the command or situation center to gain better overall picture from the situation and to utilize the separate videos from the field. If the image is up to date it could also reveal new threats. For example there might be patients that have walked away from the scene in a shock. In order to form this kind of view there needs to be sharp snapshots in a form that can be consolidated into one map. The source of this kind of pictures might be a radio controlled camera drone or sharp and recent satellite pictures. In both cases more resources in devices and data communications are required.

Responders are usually carrying their own smartphones in the field. Used solutions enable PPDR officials and partners to deploy the Android app easily. This allows first responders to use their own smartphones for emergency communications in situations where communications become difficult or jams completely.

VII. DISCUSSIONS

In the future, it would be important to investigate real-time situational awareness solutions with micro air vehicles (MAVs) [22].

A remotely piloted or programmed MAV could bring the necessary added value for emergency and rescue services. According to Tikanmäki´s [23] research using unmanned air vehicle´s improve situational awareness.

There are also new kind of real-time awareness -solutions under the development. Epson and the National Institute of Information and Communications Technology (NICT), conducted tests to explore the feasibility of a new post-disaster rapid-response system.

The NICT provided a system for linking a super high-speed Internet satellite, with unmanned aircraft systems (drones) to enable wireless communications during disasters. System would allow images taken by a drone flying above regions devastated by disasters to be transmitted in real time via satellite [24].

PilotGaea GISDK 3D system allows real-time rendering of UAV full motion video on 3D GIS platform with flight position and orientation. It is UAV flight simulations and a flexible flight information display system, allowing the overlaying of UAS video with GIS simulated landscape and GIS [25].

It can be concluded that PPDR actors over the Western Europe are waiting for common operating model for decision makers. However, all PPDR ICT solutions need critical communications systems. There is a growing dependence and interest of military and civilian security actors on satellite communications not only during crisis and disaster, but also in every-day routine. It is a unique capability ensuring long-distance communications and broadcasting. It facilitates the use of mobile or deployable platforms as a substitute or support for ground-based communication infrastructures and to cater for the exchange of large quantities of data. Satellite communications is often the only possibility for public protection and disaster relief to communicate when they have to intervene in distant areas where the ground infrastructure is damaged or destroyed, using mobile or deployable systems.

A very important factor in critical communications systems, in addition to reliability and security, is a concept called Common Information Sharing Environment, or in short CISE. CISE is since 2009 being developed jointly by the European Commission and European Union / European Economic Area Member States including civilian and military authorities as well as the European agencies operating in the maritime field. It will create a political, organizational and legal environment to enable information sharing across the seven relevant sectors/user communities (transport, environmental protection, fisheries control, border control, general law enforcement, customs and defence) based on existing and future surveillance systems and networks with a view to achieve a fully operational CISE by 2020 [26].

In addition to providing multichannel communication, non-reputability, encryption, and security, the DSiP architecture provides means for solving complex compatibility issues providing interface and process ontology and methods.

One fresh point of view is how to utilize social media in catastrophe situations. Nowadays most of the citizens carries mobile devices with camera all the time. However, in Finland this possibility has hardly been utilized at all for forming situational awareness. For example in Sweden public-safety answering points (PSAP) have situational picture function [27] that helps them to form picture of the scale of the disaster and share this information with safety, fire and rescue authorities. Further, this information helps to allocate resources accordingly. With such a large quantity of photographs flooding the web. CrowdOptic's technology, which includes sensor data smoothing, EXIF data mining and focal analytics, is instantly deployable in a range of mobile applications and technology environments to enhance security. Instead of focusing purely on where photographs were taken, their goal is to determine what that photos were taken of [28].

UN and Nato's research institutions have developed decision support systems that make it possible to improve the an overall situation awareness.

For example the Emergency Relief Coordination Centre (ERCC) in the United Nations Office for Coordination of Humanitarian Affairs (OCHA) in Geneva acts as GDACS Secretariat [29]. Global Disaster Alert and Coordination System (GDACS) is a cooperation framework between the United Nations, the European Commission and disaster managers worldwide to improve alerts, information exchange and coordination in the first phase after major sudden-onset disasters. It includes disaster managers and disaster information systems worldwide and aims at filling the information and coordination gap in the first phase after major disasters [30].

GDACS provides real-time access to web-based disaster information systems and related coordination tools. Annual GDACS stakeholders meetings are attended by disaster managers, scientists, map experts, webmasters and other professionals, to define standards for information exchange and a strategy for further development of its tools and services [30].

The Euro-Atlantic Disaster Response Coordination Centre (EADRCC) is NATO's principal civil emergency response mechanism in the Euro-Atlantic area. It is active all year round, operational on a 24/7 basis, and involves NATO's 28 allies plus 22 partner countries. The Centre functions as a clearing-house system for coordinating both requests and offers of assistance mainly in case of natural and man-made disasters [31]. Attitudes must changes to introduce such a cross-border decision support system in Finland.

VIII. CONCLUSIONS

The case study findings can be summarized so that the used technology is useful. Having the right piece of information at the right time can literally save lives, money and resources.

The applied real-time situational awareness solution enhanced different PPDR actors to do their duties during the accident. However, usability and technological innovations must move to the same direction. A correct and reliable situational awareness solution will require an understanding of what are the real user-needs. Technical solutions are not essential if they are not useful.

The real time pictures and videos from the scene could be

gathered from social media, but that binds more employees to search and follow several data sources with plenty of irrelevant information: the useful data could be a needle in a haystack. Therefore, providing the audience a separated system for capturing live video with their mobile devices could be a better option, that would also be easier to make compatible with the systems and procedures developed for the authorities.

Harnessing the power of civil activity and the capacity of mobile devices, combined with a centralized real-time situation awareness system, could form a decision support system, that would serve effectively all the authorities in all the situations described. With help of crowdsourcing useful information can be reached with aid from volunteer associations available. Emergency accommodation or food supply is easier to arrange when demand is equal to supply. Along with local situation and command centers this data could be provided to the Government in the most wide and massive disasters.

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How a real-time video solution can affect to the level of preparedness in situation centers

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Abstract: - European Public Protection and Disaster Relief (PPDR) services such as law enforcement, firefighting, emergency medical and disaster recovery services have recognized that the lack of interoperability of technical systems limit the cooperation between authorities.

Also Finnish PPDR authorities and politicians have recognized the importance of a common situational awareness in preparation for the future. When the purpose is to work effectively towards a common goal or solve various challenges, accurate and reliable information as a basis for situational awareness is needed. It is also called as a common overall picture. This study was conducted on the ground by visiting situation and command centers located in the Turku area. The Southwestern Finland Police department, the Southwest Finland Emergency Services, the Hospital District of Southwest Finland and the Finnish Border Guard in Turku have their own situation/ command centres.

The main purpose of the study was to find out local level factors which affect to utilization of situational awareness system. The aim was also to research the level of preparedness in regional administration including local PPDR departments. The other important research topic was the level of preparedness to implement new technology in the local PPDR departments.

The study indicated that the situation centers have been created to serve their own needs and different PPDR authorities have different level of preparedness. They hardly communicate with each other. The PPDR authorities have created a closed communication environment of the authorities, which will not open until different PPDR authorities gather together at the scene of the accident.

The main results can be summarized so that the operational field work of the PPDR authorities should be more standardized so that implementing new technology would be profitable. The lack of cooperation between situation centers prevent to create common situational awareness. Starting cooperation at the scene of the accident is not enough in a major accident for example nuclear disaster occurs.

In addition, various information system projects such as KEJO and ERICA will change people's cooperation and working environments. A human is still the decision maker at the scene of the accident, although different kind of decision support systems have become a part of decision-making.

Overall situational awareness can be reached in the public sector only if there are technological, human and material resources.

Key-Words: - ERC, DSS, situation center, preparedness level, situational awareness